Emerald Insight

Aircraft Engineering and Aerospace Technology

Farnborough report

Article information:

To cite this document:
, (1978),"Farnborough report", Aircraft Engineering and Aerospace Technology, Vol. 50 Iss 10 pp. 4 - 19
Permanent link to this document:
http://dx.doi.org/10.1108/eb035488

Downloaded on: 18 July 2016, At: 20:05 (PT)
References: this document contains references to 0 other documents.
To copy this document: permissions@emeraldinsight.com
The fulltext of this document has been downloaded 63 times since 2006*

Users who downloaded this article also downloaded:

(2008),"Contents", Frontiers of Economics and Globalization, Vol. 3 pp. xi-xix

Access to this document was granted through an Emerald subscription provided by emerald-srm:187202 []

For Authors

If you would like to write for this, or any other Emerald publication, then please use our Emerald for Authors service information about how to choose which publication to write for and submission guidelines are available for all. Please visit www.emeraldinsight.com/authors for more information.

About Emerald www.emeraldinsight.com

Emerald is a global publisher linking research and practice to the benefit of society. The company manages a portfolio of more than 290 journals and over 2,350 books and book series volumes, as well as providing an extensive range of online products and additional customer resources and services.

Emerald is both COUNTER 4 and TRANSFER compliant. The organization is a partner of the Committee on Publication Ethics (COPE) and also works with Portico and the LOCKSS initiative for digital archive preservation.

*Related content and download information correct at time of download.

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

FARNBOROUGH REPORT

It was a good Farnborough Show . . . for those who went to see the flying displays and the weather was a great consolation. But it was an unusual Farnborough in some respects, first because of the good weather and this does bear repetition, and it does make such a difference to setting up the Show to its progress through the week and to the mood of the people there.

Surely there is nothing worse than sloshing around in wellingtons, digging out the motor transport, coping with gale force winds and wishing that there was some form of central heating in the Exhibition Halls and the Chalets and that the outdoor exhibits really should be indoors.

But, this we could forget: in fact, it was even difficult to remember the worst years . . . and we did not try hard.

While restating the comment that it was a good Farnborough to the weather as those who went to watch, one drew the conclusion that it was also quite good for most of the Exhibitors. And, of course it was a good "British" happening, in spite of its international tag.

On the flying side there is not much one can add to the television presentations of the Show and the reports of our weekly contemporaries and it is sufficient to largely refer to the "Specials": in other respects it was just like any other Farnborough which is perhaps rather unfair because one tends to take for granted the precision of the magnificently planned flying programme and the "matter of fact" commentaries.

The "Specials" it is thought were the advent of the SEA HARRIER and the Ski jump technique demonstrated in public for the first time.

The latest version of the unique Harrier "Jump Jet"—the Sea Harrier FRS Mk 1—was flown for the first time.

And amid widespread overseas interest, the aircraft made its international public debut with military teams from all over the world seeing the demonstration.

Sea Harrier is a radar-equipped "Jump Jet" with a new avionics fit and exterior changes that include a raised cockpit for improved visibility.

There are 34 Sea Harriers ordered for the Royal Navy with the aircraft scheduled to enter service in the latter half of next year. In defence of the Fleet, Sea Harrier will operate in the fighter role.

First flight took place on Sunday, August 20, at British Aerospace's Dunsfold, Surrey, airfield. Chief Test Pilot John Farley was at the controls for the 35-minute flight.

The aircraft demonstrated three vertical take-offs, a short take-off, several rolls, performance hovers and vertical landings.

A number of overseas navies have expressed interest in the Sea Harrier which will be capable of operating from smaller and more economic ships than conventional fighter aircraft.

In the 1980s Royal Navy Sea Harriers will fly from the new "Invincible" class of British Command Cruisers — now in-build and being equipped with a bow-mounted "Ski Jump" ramp that further boosts performance.

Other aspects of British Aerospace in the flying displays were:

The Anglo-German-Italian *Tornado*, produced collaboratively with MBB of Germany and Aeritalia of Italy, is British Aerospace's largest military aircraft programme with two versions for Strike and Air Defence (80 per cent common) now in production. The initial requirement is for 809 aircraft for the Royal Air Force, German Air Force and Navy and Italian Air Force.

Advanced technology features for *Tornado*'s operational flexibility are variable geometry wings, two three-spool, reheated turbofan engines and advanced nav/attack systems for Strike and Air Defence.

Two Tornadoes are featured at Farnborough. Prototype 08 was on static display while prototype aircraft 03 flew with weapon loads representative of that required for long-range low-level interdiction strike sorties. During its development programme, Tornado has already flown with weapon loads weighing more than 16,000 lb (7,260 kg).

Flight development of Tornado is forging ahead with the flight test envelope extended to over 90 per cent complete with over 2,000 hours flown.

The *Hawk* in service with the Royal Air Force, is today's new generation combined ground attack/trainer aircraft for service through to the 21st century.

Hawk has carried up to 6,500 lb (2,886 kg) of weapons on five pylons and is powered by the Rolls-Royce Turbomeca Adour turbofan of 5,300 lb (2,450 kg) static thrust. In training it sets unsurpassed standards for flying qualities, performance and economy.

Two Hawks took part in the flying display. British Aerospace's own demonstrator G-HAWK, flying with a variety of large weapon loads to demonstrate the aircraft's suitability in the ground attack role while a trainer Hawk, as used by the RAF, carried out an aerobatic display, demonstrating the aircraft's outstanding manouvrability.

Jaguar International, the up-rated specialist export variant to the successful Anglo-French Jaguar strike/operational trainer now in front line service with the RAF and l'Armee de l'Air, made its first public demonstration fitted with the new Adour "Dash 58" engines.

Flight trials results with this engine development have shown thrust increases to + 40 per cent under combat conditions and + 15 per cent on take off, when compared with the basic Adour Mk 102 engine, at no expense to the specific fuel consumption.

The new *Nimrod AEW* (*Airborne Early Warning*) *Mk 3* was flown; this was the Comet trials aircraft which is being developed for RAF service from 1981/82. With mission system avionics by Marconi Avionics, AEW Nimrod will provide early warning for the UK

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

air defence region of NATO, giving full capability over land and water and complete inter-operability with any other AEW type.

Other new Nimrod developments include conversion of the RAF's Mk 1 Fleet to a Mk 2 standard to maintain Nimrod's Anti-Submarine Warfare and Maritime Reconnaissance superiority through to the end of this century.

Coastguarder

The latest development of the 748 family of twin turbo prop aircraft, the maritime patrol aircraft made its Farnborough flying debut.

Coastguarder's high-definition Marec radar can cover nearly half a milion square miles of ocean in just one sortie providing a cost-effective means of monitoring activities and protecting resources within 200 mile coastal limits. For full tactical flexibility the radar is integrated with the aircraft's tactical navigation system.

The *Bulldog 120* basic and aerobatic trainer, which has now won over 300 orders from 11 operators in 9 countries, was demonstrated. Powered by an Avco Lycoming 200 BHP fuel injection engine, Bulldog has proved outstanding in many other roles including military observation, weapon training, light strike, radio navigation and airways training, instrument flying and supply dropping.

BAC 1-11

The high performance capabilities of the latest One-Eleven twin jetliner development, the *One-Eleven 670*, was demonstrated in the flying display by British Aerospace's own development aircraft G-ASYD.

The 670, with aerodynamic refinements, improved braking and quieter engines, is the latest development of the "high performance shortfield" One-Eleven 475 version. It offers better airfield performance, greater range from short runways, lower noise levels and a new cabin styling. Seating up to 89 passengers, the 670 is initially being offered to Japan as a twin turbo-prop replacement for operation from 1,200 metre (4,000 ft) airfields. These new development features can also be applied to the 99-119 seat "mainline" One-Eleven 500 Series for both scheduled and inclusive tour operation.

A major new agreement signed with Romania for the licence production of around 80 One-Elevens over the next 15 years is the largest such industrial programme involving the transfer of technology in the history of transport aircraft. The programme will move in phases towards the eventual complete assembly of One-Elevens under licence in Romania in parallel with continuing production in Britain.

Total One-Eleven sales now stand at 224 aircraft worth around £390 million, including over 40 aircraft for corporate and business executive use.

HS 125

Since its maiden flight in 1962, the 125 has been progressively improved and the current version, demonstrated at Farnborough, was the fan-jet Series 700, which is powered by two Garrett AiResearch TFE-731 engines. The 125 carries from 7 to 12 passengers plus 2 crew and can fly stages of up to 2,300 nautical miles.

AIRBUS

Another "Special" was the European A300 Airbus for which British Aerospace (thanks to the commercial foresight of Hawker Siddeley) are responsible for the design and production of the high technology wing. Considerable "eve of show" conjecture abounded as to Britain's future role with this remarkably successful aircraft.

And, Secretary of State (for Industry) Eric Varley had this to say just two days before the Show opened:

"British Aerospace have informed the Government that they wish to become a full partner in Airbus Industrie from January 1, 1979, on the basis of an agreement they have negotiated between themselves, Aerospatiale and Deutsche Airbus. The Government have decided to endorse the agreement initialled by the three industries and are hoping for a similar approval by the Governments of the French Republic and the Federal Republic of Germany.

"Some questions raised by the other Governments have still to be resolved. These are being pursued urgently.

"If the agreement is accepted by those Governments British Aerospace would take a 20 per cent share in Airbus Industrie and would play a full part in the development and manufacture of the A310 derivative (formerly known as the B10) of the A300B Airbus.

"A matter of particular concern to the other Governments is the prospect for a British Airways order. We have therefore sought the advice of British Airways, who in the course of their analysis of their future requirements have had close contact with Airbus Industrie and have given particular attention to the A310. The Government accept, as I have mentioned, British Airways' conclusion that their immediate requirement is met by the acquisition of narrow-bodied aircraft of medium size and range, but British Airways consider on the basis of existing comparisons that any requirement for wide-bodied aircraft of medium size and range could most satisfactorily be met by the 310. The Government have therefore welcomed British Airways' intention to continue their close contact with Airbus Industrie in order to study the application to their fleet of the 310 in a Rolls Royce engined version."

As we go to press one is tempted to say there is nothing more to add, but this does not take account of Sir Freddie Laker's repeat performance of his support for the VC10 and BAC 1-11 and his declaration of intent to acquire six European Airbus aircraft.

And, another "Special" of a sort, because of its significance in the build-up of USAF Wings in England was the FAIRCHILD A 10.

The USAF/Fairchild A-10 Thunderbolt II is a single-place, straight-wing tactical aircraft optimised to deliver aerial firepower against enemy armour and mechanised forces. Powered by twin turbofan engines, it is capable of both giving and taking tremendous amounts of punishment in the battle-intense environment, such as would be found in a conventional war in Central Europe.

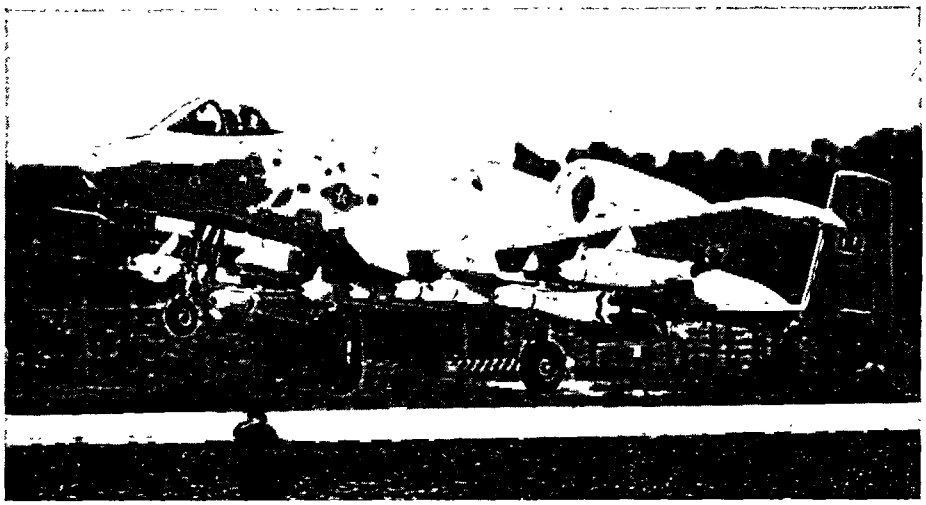
With a wingspan of 57.5 feet (17.53 metres), the A-10's design is an optimisation of STOL (Short Take-Off and Landing) performance, radius of action, maneuvrability, loiter, flexible mix payloads and airspeed, plus low-cost operation and maintenance. These characteristics, together with its immense firepower, make Thunderbolt II an ideal aircraft to support the US Army's combined arms team of infantry, helicopters, armour and artillery required to turn back a massive enemy armoured and mechanised assault.

The most revolutionary weapon on the A-10 is the internally mounted GAU-8/A Gatling gun—a high-velocity 30 mm weapon that can fire either 2100 or 4200 rounds per minute.

A seven-barrel gun, the GAU-8/A is located forward in the fuselage of the aircraft. To balance the 21-foot (6.4-meter) gun, which is offset to the left allowing the firing barrel to be on

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007



centerline, the nose gear is offset to the right side of the aircraft, a distinctive visual feature during taxiing operations.

Thunderbolt II can carry up to 8 tons (7.3 metric tons) of ordnance on 10 of 11 underwing pylon stations simultaneously. This ordnance includes both conventional and precision - guided weapons, rockets, electro-optical guided missiles and bombs, plus countermeasures. However, because of high productivity of the gun, loads tailored to the combat scenario would nearly always be used.

Two major factors in the A-10's effectiveness as a ground attack aircraft are its survivability and manoeuvrability.

Design plays an important role in the A-10's survivability. Redundant primary structural elements can withstand major damage; self-sealing fuel cells and surrounding void areas are protected internally and externally by fire-retardant foam; and a "manual reversion" flight control systems permits the pilot to fly and land the aircraft with all hydraulic power lost. In addition, the two turbofan engines are widely separated above and forward of the aircraft's horizontal stabiliser, making them difficult to destroy simultaneously. The tail design also aids in partially masking the engines from heat-seeking missiles.

Highly manoeuvrable, the A-10 is capable of delivering weapons at speeds of up to 450 knots (834 kilometers per hour). However, Thunderbolt II achieves its optium performance at lower airspeeds and altitudes where it can integrate itself into the dynamics of the battlefield situation to identify and strike close air support targets.

With its STOL capability, it can operate in and out of small forward airstrips. Additionally, it can stay in the battle area for hours, keeping constant pressure on the enemy. Adverse weather has little effect, for the A-10 can operate beneath ceilings of 1,000 feet (305 metres) with less than two miles (3.2 kilometres) visibility.

Major goals of the A-10 were simplicity and low cost. Basic to this is a structural concept that features single curvature and constant cross-section design as much as possible, permitting ease of repairs, especially in forward operating locations. Some 64 per cent of the aeroplane most likely to be hit by hostile fire is replaceable in 12 hours and 74 per cent within 24 hours.

Approximately 95 per cent of the airframe is constructed from aluminium. To reduce the number of spare parts, many components are interchangeable right or left; i.e., landing gear. ailerons, rudders, elevators, control actuators and engines.

Once again there was a good showing by WESTLAND but the only "Special" here was the WESTLAND SEA KING making its first Farnborough appearance in the Royal Air Force colours.

And speaking of Westland although it did not take part in the flying display reference must be made to Westland Wideye, the remotely piloted helicopter that made its successful first flight on August 24, 1978.

The Westland Wideye is the remotely piloted helicopter of the Supervisor Surveillance system.

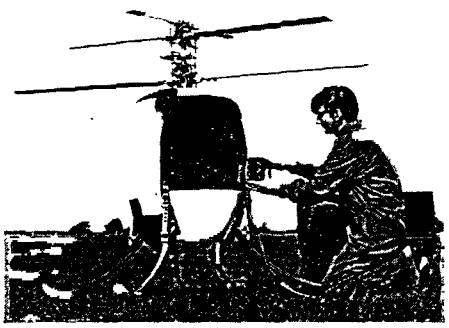
Supervisor is being developed for the Ministry of Defence (PE) by Westland Helicopters and Marconi Avionics, to meet the requirement of a surveillance system capable of reconnaissance at distances up to 50 km beyond the forward edge of the battle area. The system is to be ready for service in the early 1980's.

Wideye and the Supervisor system are currently undergoing evaluation to define the full operational system before it goes into full scale production. Wisp, the smaller Westland RPH, which has been flying for the past two years, is taking part in the Wideye development programme.

In its current phase, the Ministry of Defence programme calls for the manufacture and flight testing of a small number of Westland Wideye vehicles.

Hardware built for ground and flight evaluation comprises Wideye remotely piloted helicopters containing the electronic package, and a ground station truck on which a tracker is mounted.

Westland Helicopters is responsible for the Wideye RPH. Marconi Avionics provides the helicopter's payload and, with Westland Helicopters, the fully equipped ground station vehicle. The helicopter carries a small, stabilised camera sensor and two-way radio link, to convey commands from the ground to the helicopter, and to relay video data from the RPH to the ground vehicle. The ground station comprises tracking antenne, data processors, control console and vido monitors.



WESTLAND WIDEYE LEADING PARTICULARS

Height, undercarriage deployed	6 ft
Height, undercarriage retracted	5 ft
Diameter of co-axial rotors	2 ft 5 in
Maximum body diameter	7 ft
All-up-weight	275 lb
Power plant	two 18 hp piston engines

GENERAL AVIATION

On the General Aviation side is the increasing significance of Business Aircraft and this was largely demonstrated by CSE Aviation who were mounting their biggest ever display with products such as Piper, Learjet, Bell helicopters and Embraer aircraft. CSE are also distributors of a whole range of specialised general aviation equipment including Lycoming and Rolls-Royce Continental engines, King Collins and Bendix radios, Sperry Flight Systems

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

and the Frasca Flight Simulator.

The exciting new Piper Tomahawk (G-OATS) of the Oxford Air Training School was seen for the first time in the skies over Farnborough. The school will shortly be adding 18 of these aircraft to its present fleet of over 50 aircraft.

The Embraer range of aircraft was entirely new to Farnborough; built in Brazil at the largest aircraft factory in the southern hemisphere. CSE are sole distributors for the UK and parts of Africa. Star of the Embraer product line is the P110 "Bandeirante" mini-airliner which this year entered service in the UK with Air Wales and Air Ecosse. The essentially simple and rugged Bandeirante is gaining a world-wide reputation as a "third level carrier aircraft" and can carry up to 19 passengers in airline comfort as far as 650 miles. Powered by Pratt and Whitney (Canada) turbine engines the Bandeirante is unpressurised and costs in the region of £850,000. On show too was the Bandeirante maritime version with full search radar and attack weapons.

Also flying was a model 35A Learjet. Learjets are now certified to fly at 51,000 ft., an altitude nearly 2 km higher than any other aircraft, other than the Concorde.

CSE ARE DISTRIBUTORS FOR:

Piper Aircraft
Gates Learjet
Empresa Brasileira de Aeronautica SA
Bell Textron Helicopters
Rolls-Royce Continental
Avco Lycoming
Hartzell Propellers
McCauley Propellers
Bendex Fuel and Ignition Systems
Marvel Schebler Carburettors
Champion Aviation Spark Plugs, Igniters, Oil Filters
Garrett Airesearch Turbo Chargers
Stewart Warner Heaters
Prestolite Electrical Equipment
Bendix Avionics
Rockwell-Collins Avionics
King Radio Avionics
Narco Avionics
Sperry Flight Systems
Pantronics Corporation
Piper/Mitchell Auto-pilots
Met-Co-Aire Tip Tanks
Jeppesen Airways Manuals and Services
Frasca Flight Simulators

The French Aeronautical and Space Industry:

The French industry will be represented, first, in order to display its more recent products and secondly, to stress its significance on the international level.

The French exhibit had four aspects.

The GIFAS stand located in one of the exhibit halls, unites the displays of 30 exhibitors. Some 10 other firms, which for the major part, co-operate with foreign firms, were stands other than the GIFAS one.

Both MATRA and INTERTECHNIQUE will have individual displays independently of the GIFAS stand.

Ten reception chalets of varying sizes at which GIFAS and nine firms received guests.

A static or ground display which included: the **Mirage 2000, Mirage F1,** two **Alpha Jets,** one **Falcon 10** and one **Falcon 20,** the**Transall** and **Fouga 90** plus a military version of the **Rallye.** Also on view a dozen rocket and missile types laid out around the twintube **MM 40** firing unit presented by Société AEROSPATIALE, plus MATRA missiles and weapons.

Participation in the flight demonstrations, the **Mirage 2000** (single jet, SNECMA **M.53),** the new DASSAULT-BREGUET fighter was seen for the first time in public.

Among the other productions demonstrated were the DASSAULT-BREGUET **Mirage F1** (one SNECMA **Atar 9K50),** the **Alpha Jet** (two SNECMA-TURBOMECA **Larazac 04's)** and the jet-propelled executive aircraft **Falcon 10** and **20.** Société AEROSPATIALE displayed the military cargo **Transall** (two ROLLS-ROYCE-SNECMA-MTU **Tynes),** the helicopters **SA 365 Dauphin** and **AS 350 Ecureuil** and the light **Rallye** aircraft built by SOCATA, in farm, and towcraft versions and equipped with the "Atal" system.

The remarkable strides made in recent years by French aeronautical equipment was clearly illustrated at the last Le Bourget Air Show by the full-scale transparent model of the **Mirage F1** showing all the French equipment and systems carried.

This model was displayed again at the centre of the GIFAS stand.

It is the only model of its kind in the world and was an attraction for specialists and visitors, before being shipped back to Paris where it will find a permanent home in the Air Museum at Le Bourget, where a special new hall has been set aside for the French industry.

Another "Special" was the MIRAGE 2000.

The pure delta wing arrangement is a revival of the former aerodynamic feature with the new Mirage 2000 which may seem surprising at first sight. Moreover, from an apparent outline similarity with the Mirage III design, the new aircraft could just appear as an advanced version of the other, still in production after 20 years. In the entire history of aviation, such a long life is a unique case for a combat aircraft.

In fact, the Mirage 2000 is an entirely new aircraft.

In the fifties, the delta-wing design was widely used, as offering a number of advantages:

- Light and simple structure.
- High wing thickness figure, for a thin airfoil relative thickness (actual proportion of the wing thickness divided by the airfoil chord length).

This advantageous thickness in turn offered:

A large inside volume for fuel tank accommodation.

A possibility of designing structural parts with generous dimensions, thus sturdy and easy to produce.

Good supersonic flight behaviour.

- A relatively large wing area for a low drag figure, involving a reduced wing loading and better manoeuvrability.

The delta-wing configuration however has a major drawback: it does not allow conventional lift improvement devices. And high-lift factors, as normally required for take-off and landings, can be obtained only at high incidence. The corresponding nose-up attitude, derived from a strong upward deflection of the "elevon" control surfaces, introduces:

- A serious loss in the lift factor, as compared with the theoretical figure.
- A drag increase.

To offset the lift loss, the design engineer must:

- Increase the wing area (with corresponding weight and drag penalties).
- Accept high take-off and landing speed figures.

A good compromise is possible, as demonstrated with the Mirage III. But a conventional swept wing, easily accepting lift improvement devices

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

(flaps and leading-edge slats), and combined with a conventional tail structure, will however provide a better low speed performance.

One of the key features for supersonic flight in a very low airfoil relative thickness. But the necessarily quite short chord of a swept wing means an extremely thin wing structure. This was out of reach of the production technologies available in the past years. But as soon as permitted by technical progress, the Mirage F1 series was launched, with a wing area of 25 sq m (only 269 sq ft), however offering a lower landing speed than the 35 sq m Mirage III (376 sq ft), with better low speed flying qualities.

Anyway, since the delta-wing configuration still retained all its basic advantages, various methods were devised to offset its defects, such as installing front elevators, in so-called "duck-tail" arrangement, in turn bringing some drawbacks.

Theoretically, by moving aft the centre of gravity, the flying performance could be improved, but the aircraft would thus become practically impossible to handle for a pilot.

Meanwhile, three new factors were brought along, in the wake of a steady technical progress:

- Currently improved jet engine performance permitted a higher thrust/weight ratio, with a thrust figure nearly as high as the aircraft weight (1.0 ratio).
- Refinements in aerodynamic technology, derived from computer aided design, permitted highly optimised aircraft shapes, thereby improving the overall lift/drag balance, particularly with an automated cambering of the wing leading edge.
- Electrical flying-controls were also introduced, combined with advanced electronic data pick-up devices.

Inherent instability behaviour of an aft-centred delta wing actually exceeds possible reactions of a pilot, however fully trained, as regards quick sensing and corrections.

In order to obviate this tricky problem, chain of modern control means could however be introduced:

- Highly sensitive pick-up devices, comprising linear and rotation accelerometers, to direct every aircraft motion with accuracy.
- An airspeed data central unit, to provide a constant information on actual aircraft aerodynamic situation.
- High capacity computers, to have flight data combined with various information on pilot's physical behaviour (actions on controls).
- Thus a quick and efficient system of electrical flying-controls, regularly receives a digest of available data, as processed by the computers. Artificially acting on the controls to introduce a synthetic stability, the system permits an aft C.G. location which normally gives a highly unstable aircraft. The electrical flying-control system moreover actuates the leading-edge slats, all over the subsonic-transonic speed range.

The aircraft flight behaviour is thus optimised in the entire flight performance envelope.

In this state of synthetic stability, the Mirage 2000 however flies in complete safety with four reliable circuits, obviously offering no risk of malfunction at the same time. Additional safety is still provided with a fifth, entirely independent, emergency circuit.

WING-FUSELAGE FILLET

The Mirage 2000 design engineers selected a wing-root fairing arrangement of substantially larger size and radius than on previous aircraft. Moreover wing-root thickness is also quite larger.

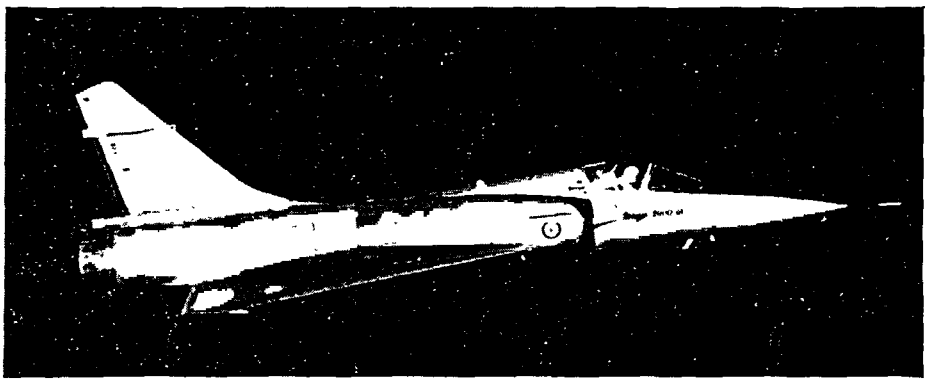
These two combined features of the new Mirage 2000 wing design provide the following advantages:

- Better stress distribution in the wing-root structure.
- Better stress transmission between wing and fuselage structure.
- Easier arrangement of the landing gear within the structure.

All this in turn means a substantial weight-saving, over the entire central section of the aeroplane structure.

NOVEL STRUCTURAL MATERIALS

Most advanced construction methods have been adopted for the structure design of the Mirage 2000, always with a view of combining sturdiness with a low weight.



Basic requirements for air supremacy and interception missions involve a very high thrust/weight ratio. In its initial development stage, the thrust of the new M53 jet engine being expected around 9 tons (20,000 lbs), a critical condition was to reduce as much as the Mirage 2000 operational weight. In other words, the new aircraft should not be heavier than the Mirage III, in spite of a much more powerful engine and a larger wing area.

Various means have been devised to obtain this weight-saving, but the main asset of Dassault-Breguet design engineers in this respect certainly was their unmatched and continuous experience in delta wing development over the last 25 years. This technical background saved much precious design time, permitting a quick optimatisation of the new aircraft features.

Integrally stiffened structure sections were therefore widely used, together with chemical milling and special metals as titanium. But, beyond such now conventional structural features. Dassault-Breguet design engineers have widely relied on new composite carbon-fiber and boron-fiber materials, for a number of parts. This is for instance the case for the tin torsion-bax, for all flight-control surfaces, for the large radio-bay door on the fuselage, and for the underwing closure panels of the landing gear wells.

Using such an advanced technology throughout the Mirage 2000 structural design, a weight-saving of some 20 to 25 per cent was obtained, as compared with a conventional light-alloy structure.

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

HIGH-PRESSURE HYDRAULIC SYSTEM

After a number of such experimental circuits were tried out, the Mirage 2000 received a 280-bar hydraulic system (4,000 lbs/sq in), for the first time in France in series production. This high-pressure system permits a substantial weight-saving for two main reasons:

- Hydraulic lines and actuating cylinders have a smaller cross-section.
- The overall volume of hydraulic fluid is reduced in the system.

Also, midget-sized actuating cylinders are easily accommodated in a relatively thin wing, without any protruding fairing.

- Specific fuel consumption, dry 0.87 kg/kgp.h
- No restrictions on use of reheat in any part of the flight envelope.

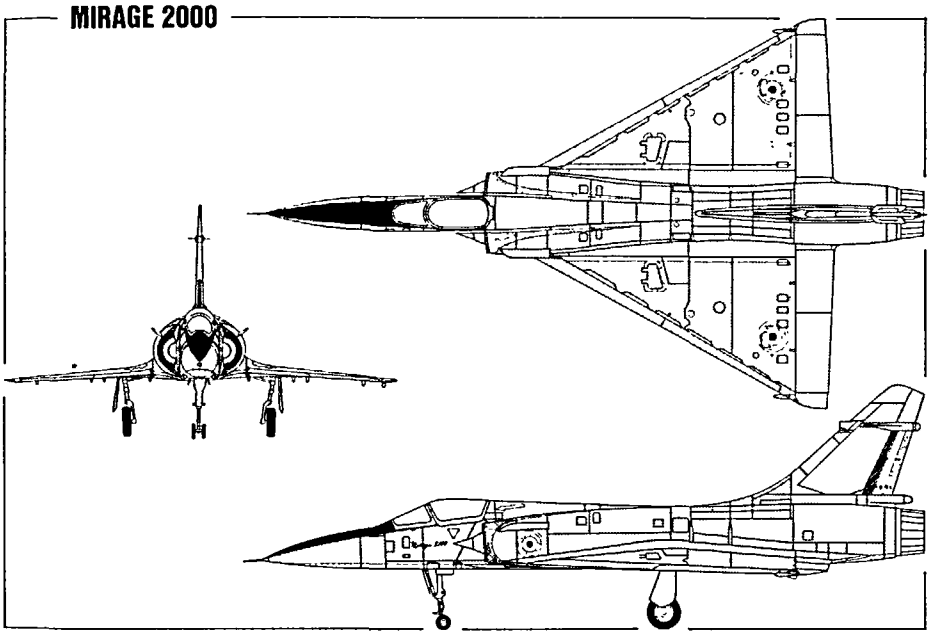
Based on a modular conception, the M.53 engine has kept the traditional qualities of simplicity and reliability of the ATAR engines.

The single shaft turbofan M.53 is equipped with:

- A 3-stage LP axial compressor.
- A 5-stage HP axial compressor.
- An annular combustion chamber.
- A turbine with two cooled stages.

The fuel control system is controlled by an electronic computer.

- Length 4,853 mm
- Overall diameter 1,055 mm
- Weight (with cold flaps) 1,450 kg



SNECMA M.53

The M.53 single spool turbofans are capable of continuous high altitude flight at Mach numbers up to 2.5. The first model of the M.53 family, the 8,500 kgp thrust M.53-2, successfully completed military qualification testing in April 1976. They are intended for the next generation of combat aircraft, both single and twin-engined.

The first application will be in the Mirage 2000.

BASIC CHARACTERISTICS

- Maximum static thrust 9,000 kgp
- Maximum in-flight thrust Mach 2.2—36,000 ft >10,000 kgp
  Mach 1.2—sea level >11,700 kgp
- Specific fuel consumption, with reheat 2.05 kg/kgp.h

Continuing the theme of items for "Special" report mention must be made of the following:

LUCAS AEROSPACE

Lucas Aerospace exhibited a wide range of major systems and equipment for civil and military aircraft and engines and also for defence applications, including fighting vehicles, missiles and underwater weapons.

Highlights of the latest developments in systems and equipment shown include:

1 Advanced analogue and digital engine control systems for helicopter engines in the 600-1100 shp range.
2 The very latest development in constant frequency a c electric power generation featuring a 60 KVA and 90 KVA Generator of exceptionally high power/weight ratio and minimal frontal area.
3 High performance fast actuators for missile control surface actuation.
4 Low NO_x emmissions development for the future generation of of civil transport engine combustion systems.
5 A high temperature dry lubrication pneumatic actuation thrust and nozzle control system.
6 Titanium brazed and bonded Honeycomb fabrications.
7 ION plating and chemical etch developments.

Exhibited also include hydromechanical engine control, small gas turbines, electro-mechanical actuation, secondary flight control and pitch feel systems, acrylic windscreens, "Spraymat" deicing equipment and electroluminescent cockpit panel and formation lighting. A ground support equipment graphics display featuring special purpose overhaul tools and test equipment for aircraft and engine systems and component and electrical and hydraulic ground power supplies.

Engine Controls

The latest developments in full authority helicopter engine electronic control systems which have been tested on several engine types and with complete transmission systems were exhibited. Two examples were shown.

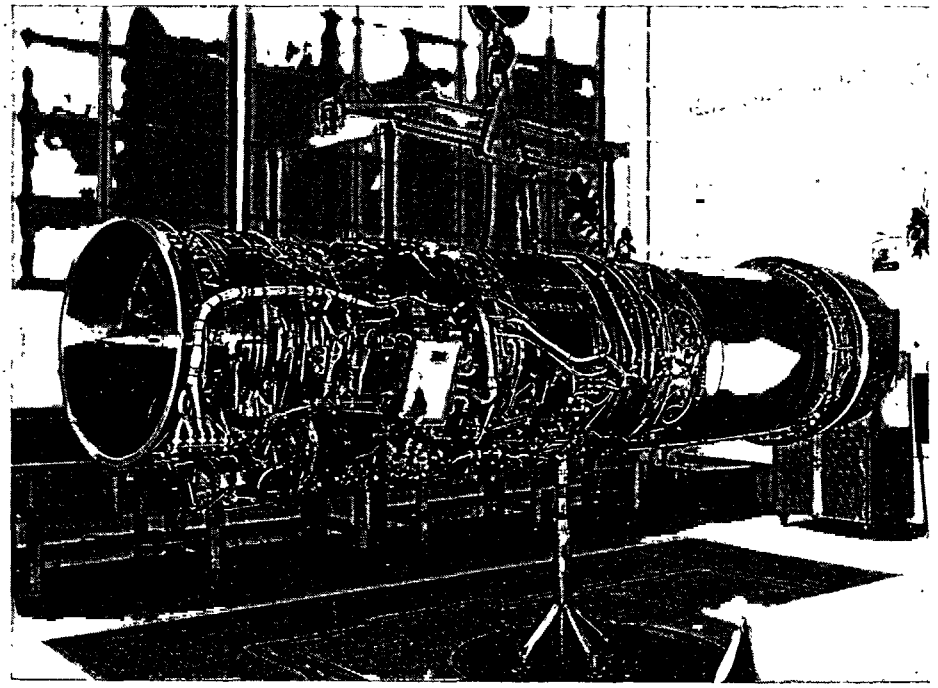
The first, type SDS 100, utilises analogue computing methods and has recently successfully completed its first trial flight test fitted to the AVCO Lycoming LTS 101 engine in the Bell 222 helicopter. The second, type SDS 200, uses a digital computer.

Both systems are designed to be flexible and modular with the electronic control unit (ECU) differing from application, while the fuel metering systems (FMS) can be supplied to cater for the needs of engines from 600 shp to 1100 shp. In addition, the various end user requirements of inlet guide van control, manual reversion, altitude compensation etc, can be incorporated as necessary.

A significant technological advance in propulsion control was featured by Lucas Aerospace in the display of the second generation full authority digital controller. This controller has been developed for current and future civil and military gas turbines and will exercise complete engine management over the entire flight envelope and is

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007



The SNECMA M.53 single spool turbofan.

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

suitable for all complex multi-variable propulsion systems.

Using multi-microprocessors with state of the art electronics, any required degree of system sophistication can be programmed giving overall powerplant control from start-up to shut-down.

Hydromechanical engine control equipment on display included centrifugal and high pressure gear type fuel pumps and associated fuel control regulators. An example of in-service experience achieved with this equipment is its application on the Rolls-Royce RB211 engine where *eight million* flying hours have been accumulated to date.

In addition, an integrated hydromechanical control for an advanced engine was exhibited.

Electrical Power Generation

Advanced lightweight electrical power aircraft generating systems exhibited included the 6/7.5 KVA 1200 RPM 400 Hz air cooled a c generator in production for the Sikorsky S 76 helicopter and, the main a c generating system designed for the Boeing YCH-47D Chinook military helicopter. The latter comprises a twin channel system, each channel comprising a 30/45 KVA 200 volts 400 Hz 1200 RPM oil spray cooled generator, associated generator control unit providing voltage regulation and system protection and a current transformer.

A highlight of the electrical power generation equipment exhibited, was the very latest development in constant frequency power generation for aircraft. This was demonstrated with the display of two compact frequency generators (CCFG) having output ratings of 60 KVA and 90 KVA respectively. Of revolutionary design, these units have an exceptionally high power/weight ratio, small frontal area and are capable of delivering 1 KVA per lb.

Electric Actuation

Electro-mechanical actuators and actuation systems exhibited range from aircraft flight control trim to missile and underwater weapon control surface actuation applications.

An example of the D C Linear Actuator supplied for flying control trim actuation on the Pilatus P6-7 aircraft was shown, together with d c rotary actuators supplied for main rotor blade trim actuation on the Westland Lynx helicopter and for a fighting vehicle application.

High performance fast actuation systems exhibited include the system selected by McDonnel Douglas for series productions on the "Harpoon" programme.

Small Gas Turbines and Engine Starting Equipment

The 87 hp gas turbine starter developed for starting the Rolls-Royce Pegasus engine in the McDonnell Douglas YAV8-B VTOL aircraft was shown. This gas turbine starter may be considered as two mechanically separate units — a compressor/turbine assembly driving an accessory gear train and a free power turbine which drives the main engine through a reduction gearbox and clutch. Designed to start large gas turbine engines, this gas turbine starting system is self-contained, using only supplies already available on the aircraft that is, fuel and 24 volt electrical power supply.

In addition to the gas turbine starter, a lightweight, high efficiency, 63 hp low pressure air turbine starter was exhibited. Other engine starting equipment on show included a high energy ignition unti which is one of a range of such units with outputs from 2 to 12 joules.

The small gas turbine display also included a model of a 470 lb thrust turbo jet engine which is one of a new range of turbo-jet and turbo-fan engines being developed by Lucas Aerospace for remotely piloted vehicle applications.

Gas Turbine Research Engine

The compressor/turbine rotating assembly of an 80/90 hp research engine designed by Lucas Aerospace was displayed. Small diameter shafts running at high speeds and high pressure ratio centrifugal compressors, are among the areas of research being undertaken.

The centrifugal compressor is designed for an 8:1 pressure ratio and incorporates an advanced technology diffuser. In its present form, this unique engine provides gas, but if converted to a power turbine configuration, would give 80 shp at a shaft speed of 110,000 rpm.

Air Control Valves

From a wide range of high temperature air control valves designed for pressure regulation and ON/OFF control for engine and wing hot-gas anti-icing, air turbine starter and environmental control, two examples were exhibited. These comprise a $1\frac{3}{4}$ in diameter ON/OFF air control valve selected for engine anti-icing on the Avco Lycoming ALF 502 engine in the Canadair Challenger aircraft and, a $2\frac{1}{2}$ in diameter ON/OFF and regulating air control valve for cowl anti-icing on the General Electric CF 6 engine in the Boeing 747 aircraft.

Ballscrews

Recirculating precision ballscrews

© Emerald Backfiles 2007

were exhibited which form part of the tailplane trim, flap and slat actuation system on the A300 aircraft. Also, the ballscrew supplied for the Boeing 747 wing leading edge flap system is shown.

Metal Fabrication Combustion Technology and Automatic Test Equipment

Lucas Aerospace also featured by means of visuals and hardware their overall capability and skills in fabricating sophisticated metals and the technology of honeycomb structures using bonding and brazing methods.

Among the many projects being highlighted are Rolls-Royce/Turbomeca "Adour" engine manifolds for the "Jaguar" aircraft; a selection of combustion chambers and fuel sprayers; RR "Spey" engine afterburner system installed in the "Phantom" aircraft; a section of a brazed titanium honeycomb panel chemi-etched for weight reduction.

Actuation and Control Equipment

Examples of airframe and engine hydraulic/pneumatic control and actuation systems were highlighted on the stand by hardware, models and visuals; included are the high-lift wing-sweep control unit (perspex see-through model); pneumatic engine nozzle and thrust reverser systems installed on the "Tornado" RB-199 engines with special emphasis on Lucas dry-lubrication transmission technology related to high-temperature operating environments.

Other items featured were the Lucas Hydraulic thrust reverser jack fitted to the Hurel-Dubois system installed on the Dassault "Falcon 50" aircraft and a variable-feed unit manufactured by Canadair "Challenger" twin-jet executive plane.

Cockpit Glazing and Anti-Icing Technology

The specialised knowledge of Lucas Aerospace in the manufacture of stretched acrylic sheet transparencies; electro-thermal heater mat "Spraymat" applications; electroluminescent lighting systems and glass-fibre reinforced plastic (GRP) structures was exhibited.

Ground Support Equipment

Ground Support Equipment was featured by visuals and models which illustrate the company's wide ranging activity in this field. The Division continues to supply, on a world-wide basis, overhaul equipment and special test installations for engine fuel and electrical generating systems used on wide-body-jets and supersonic transport planes, and transportable ground-test and engine start-up sets for a variety of aircraft application.

The Division's range of operational support equipment has been extended to include a 40 Kw, three-phase, 50/60 Hz generating set for military applications. Also being developed is a high-pressure hydraulic ground servicing trolley designed for military aircraft support over the next two decades.

GRAVINER

A total systems approach to man/machine survivability using advanced technology fire and explosion detection equipment was the main theme of the Graviner exhibit.

Bringing together expertise in the development of in-flight fire protection systems for both military and civil aircraft was the Graviner "Survivability Centre". Here, visitors were able to study the high technology attained in the development and manufacture of airborne fire detection and explosion suppression systems which has established it as a leader in this important field.

A key feature of the Graviner exhibit was a working display of the company's overall approach to the detection and suppression of explosions in the vulnerable "Dry-Bay" areas of military aircraft.

This display incorporated the recently developed Graviner lightweight ultra-violet flame detection system — specifically designed to operate reliably in the punishing environmental conditions experienced in combat flight— and, on show for the first time, the Graviner Dry Fluid Suppressor which has been developed for use in the crowded "Dry-Bay areas of aircraft.

Other applications of the Graviner lightweight UV system on high performance aircraft which were shown, included the detection of fire in the engine and nacelle areas together with the monitoring of afterburn ignition systems.

The company are showing a range of their civil aircraft "Dispatchability" systems. The Graviner Firewire detection system was demonstrated both in its rail mounted mode—specifically designed for easier fitment and to give greater element protection and hence improved reliability—and in its Triple FD form — which enables both the resistance and charge storage capacity of the element to be monitored, thereby permitting better discrimination against false warnings.

In addition, the Graviner discreet detection system was also demonstrated. A eutectic salt based detector, this system gives warning of every localised overheat conditions such as those that can be experienced in wheel well areas, cabin air conditioning, and for wing de-icing.

Announced on the opening day was the news that Graviner had won an important share of a significant US military development contract. Graviner has been chosen by the US aerospace company, General Dynamics, to work with them on a contract they are undertaking for the US Air Force Aero Propulsion Laboratory at Wright-Patterson Air Force Base, Ohio, to develop advanced aircraft fire detection system for future military aircraft.

A growing demand from within military aviation circles in the USA for more dependable methods of detecting and warning of airborne fires in their early stages has arisen in order to improve aircraft and pilot safety and to avoid unnecessary aborts due to false fire warnings.

The Wright-Patterson contract covers an analysis of the specification requirements and the subsequent design, fabrication and testing, including in-flight testing, of two ultra-violet flame detection systems together with their associated computer control equipment and crew warning systems.

DUNLOP

The theme of the Dunlop Aviation Division stand was the company involvement as a world-wide organisation supplying equipment for international aircraft projects. The main exhibits were structural carbon brakes, brake management systems, aircraft tyres and a range of ancillary equipment.

Structural Carbon Brakes

The Dunlop carbon/carbon composite material developed for aircraft brakes is one of the most significant advances in structural friction material technology of recent years.

OSCAR-Brake Management System

The Dunlop optimum system controlling aircraft retardation (OSCAR),

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

which was being shown, is a total brake management system concept combining components and systems matched for optium braking performance and particularly related to carbon brakes.

Apart from the basic components of tyres, wheels and brakes, this system offers "building blocks" which comprise three inter-dependert sub-systems: braking control, kid control and brake temperature control.

A safety device that gives visual indication when aircraft tyres are under inflated — a condition that can contribute to serious incidents — introduced by the Dunlop Aviation Division of Coventry, seen for the first time at Farnborough.

The new device known as "Dunlopressor", has been designed to replace the standard inflation valve cap on tyres and gives immediate warning through its visual red "pop-up" indicator, of unsafe tyre pressure. This indication is easily discernible to air crews and maintenance staff during pre-flight inspection.

Dunlopressors are calibrated and clearly marked to suit each particular aircraft operational requirement and need no further adjustment. The device is extremely sensitive to pressure drop and after tripping, the red pop-up indicator cannot be re-set until the tyre pressure is correctly adjusted.

IMI TITANIUM

IMI Titanium, Europe's largest manufacturer of titanium, illustrated on its stand the facilities at its plants for the production of titanium billet, rod, wire, sheet, and seamless and welded tube. Also on show was a selection of these products together with raw materials which are used in the production of titanium alloy ingots. IMI titanium is used in the vast majority of European civil and military aircraft introduced during the last fifteen years.

Exhibits also included examples of titanium castings manufactured by Titanium-Aluminium-Feinguss GmbH (TITAL of Velmede-Bestwig, West Germany, who are represented, in the UK, by IMI Titanium.

IMI Titanium say that . . . "Farnborough couldn't be Farnborough without IMI Titanium. When you reflect that the overwhelming majority of British, European and joint-venture aircraft on show or taking part in the flying display contain IMI titanium in engines, airframes or both."

IMI is a company with an irrevocable commitment to the aircraft industry, having been an integral part of the aerospace scene since titanium first became commercially available. IMI Titanium spearheaded the development of processes for the production of metalic titanium on this side of the Atlantic, and commissioned Europe's first titanium production plant at Kynoch Works, Birmingham, in 1954.

Developments at IMI has gone hand in hand with the requirements of aero-engine and airframe designers and has been directed towards producing alloys whose performance is being continuosly improved. IMI 829, for example, is the latest addition to the range of creep-resistant alloys and has fulfilled the need for a material to operate at elevated temperatures exceeding 550°C. At the same time, IMI Titanium has pioneered the use of titanium in non-aerospace applications with notable success in the fields of power generation, chlorine anodes and electrowining of metals.

The list of Europe's most advanced aircraft which place great reliance on IMI titanium and titanium alloys includes, among military aircraft, the Tornado, Jaguar, Harrier and Hawk, as well as Tri-Star, A300 Airbus and Concorde in civil aviation.

GOODYEAR

The diversity of products produced by the Goodyear Tyre & Rubber Company for the aerospace industry was highlighted by the products to be displayed on the company's stand.

Tyres, of course, were in evidence.

Carbon fibre disc brakes as fitted to the McDonnell Douglas F-15 and the General Dynamics F-16 were also featured on the stand, as was the anti-skid system fitted to the Tornado.

And there was a video display of Goodyear's side-looking airborne radar (SLAR), first developed for military use and now being increasingly applied to commercial use.

A video presentation of this unique side-looking radar system, originally developed for military use and now being applied to the search for the earth's valuable natural resources, was exhibited.

Militarily, the radar is in use with the US Air Force, the US Marine Corps, the US Air National Guard, the Federal German Air Force and the Japan Air Self Defence Force. It allows for improved surveillance of harbours, coastlines and border areas while operating from international waters, from behind friendly borders and beyond the range of ground-to-air defence systems.

The commercial version of Goodyear's side-looking radar is used in many countries throughout the world is geological and survey work.

From the air the radar produces imagery that can point out features of the earth's crust more distinctly than photographs. The radar looks out sideways from the aircraft, viewing the terrain from an angle, thus helping to provide geologists with information on faults and other earth formations which cannot be seen so clearly on conventional photographs.

Since the radar operates electronically, the imagery is not affected by clouds of weather.

The mapping programme so far shows promise of further significant discoveries as Goodyear cover more areas of the world and as geological interpretation of radar imagery becomes more sophisticated.

Easily recognisable as the Thames Estuary, with a large part of Essex and North Kent clearly visible, this photograph was produced with the help of Goodyear radar imagery. The white line jutting into the mouth of the river from the north shore near the centre of the picture is the one-and-a-half-mile long Southend Pier. This image was taken from about 35,000 feet. (See "Military Radar in search for world's wealth".)

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

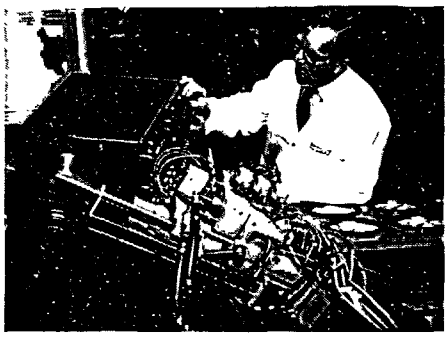
© Emerald Backfiles 2007

DOWTY

The joint presentation by nine Dowty companies of a new and established products on Stand S.27 South Hall showed the strength of the group's design and production facilities and of its participation in a growing number of production programmes. They include Challenger, Mirage 2000, Jurom, BAe 146, Aviojet, Tornado, Hawk, A.300B, TriStar, Fantrainer, Puma, Boeing 727, 737 and 747 Harrier Jaguar, F.28, Agcat, Turbo-Commander, and Viggen.

Products groups exhibited by Dowty were:

Landing gear, Propulsion equipment, Engine and fuel systems controls, Flight control systems, Hydraulic systems, Sonobuoys, Communications control equipment, Electrical and electronic equipment, Sealing products, Precision castings.



One of the primary flying control units for the Jaguar fly-by-wire demonstration programme undergoing environmental testing at Dowty Boulton Paul's Wolverhampton factory.

PILATUS/BRITTEN NORMAN

Pilatus Aircraft Ltd exhibited two PC-7 Turbo Trainers, the PC-6 Turbo Porter and the B-4 all-metal aerobatic glider. A highlight was the combined PC-7 Turbo Trainer and PC-6 Turbo Porter flying display: the PC-7 presenting an outstanding aerobatic programme including vertical eights and spins, whereas the PC-6 demonstrated once more its unmatched STOL-performance.

A PC-7 series production aircraft was presented at the static display during the first two or three days of the Show, and a full scale production mock-up of the forward and rear-cockpit of the PC-7 Turbo Trainer was exhibited at the stand.

The Receiver of Britten-Norman, has accepted the letter of offer of Pilatus Aircraft Ltd related to the take-over of the activities of Britten-Norman (Bembridge) Ltd by the Swiss firm, member of the Oerlikon-Bühle Group.

The letter of offer foresees that Pilatus Aircraft Ltd intends to purchase all the assets of Britten-Norman (Bembridge) Ltd, which include the BN facilities on the Isle of Wight and the complete Islander/Trislander production hardware (jigs and tools plus stock materials) which is presently located at the Fairey SA factory in Gosselies, Belgium.

Under the terms of the envisaged formal contract Pilatus will acquire the exclusive production and marketing rights for all BN-products. Part and license production of Islander aircraft is planned to continue in Romania and the Philippines under new agreements.

In order to re-establish confidence of BN-customers after the long period of the Fairey Britten-Norman receivership the management of Pilatus has approved and been authorised by the Receiver to start an immediate action plan to improve the sales and product support situation, including:

- A world-wide direct sales campaign as well as the immediate appointment of new or former distributors.
- A short-term programme to improve the BN-product support of the 800 plus aircraft in operation in 118 countries, including a new field service organisation and a more efficient spare parts processing centre.
- The introduction of a widely improved Islander version, called the BN2-B Islander. The new model will have an increased landing weight, better soundproofing, a new instrument panel and a large number of customer-oriented new features.
- Feasibility studies for new developments of the BN-aircraft line, including a new Turbo-Islander and further derivative models.

It is anticipated that this action plan, carried out under the supervision of Pilatus Aircraft Ltd who is known as a reliable dynamic company within the Swiss based Oerlikon - Bühle Group, will have immediate impact on the recovery and image of the Britten-Norman operation.

ROLLS-ROYCE MOTORS

The Specialist and Light Aircraft Engine Division of Rolls-Royce Motor displayed a Rolls-Royce Continental 0-240 and 10-360 and a representative model of a new series of four cylinder engines. This is to be designated 10-368 with a power range of between 160 bhp and 200 bhp and is currently under joint development with Teledyne Continental Motors of the USA.

Rolls-Royce Motors is the major manufacturer of light aircraft piston engines in Europe. The Company produces a series of five engines under licence from Teledyne Continental Motors, these are the 100 bhp—0-200, 130 bhp—0-240, 145 bhp—0-300, 210 bhp—10-360 and the 210-225 bhp—TSIO-360.

The precision Components Division of Rolls-Royce Motors was formed in April of this year to combine the production and marketing operations of the Investment Foundry Division located at Crewe and the Precision Fabrications Division at Shrewsbury.

The main business of the Division is specialised machining and the manufacture of precision castings and precision fabrications.

Precision castings in air and vacuum are produced by the lost wax process in stainless, low alloy and carbon steels and nickel, cobalt and iron based alloys.

Castings currently manufactured include components for aerospace, gas turbine engines and the automative, nuclear, catering and machine tool industries.

The specialist machining sections offer radial and creep feed grinding and electrical discharge (spark erosion) machining which together with the precision castings facilities enable the Division to provide customers with a complete manufacturing service.

The production of sheet metal fabrications and assemblies from high temperature alloys for industrial gas turbine engines has been successfully extended with improved technology to include such items as annular combustion chambers and components for the nuclear industry.

MEL

Airborne maritime reconnaissance radar, digital scan conversion systems, aircraft landing guidance systems and airborne radio equipment were featured by MEL as part of the Philips in Aviation presentation at Farnborough.

A new system, making its first public appearance is Sea Searcher, an airborne ASW radar currently under development for the Royal Navy's Sea King helicopters. Sea Searcher is to replace

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

the current Sea King radar system, effectively doubling the aircraft's radar search range. It is an X-band (NATO I-band system with selectable pulse width which allows for optimisation of target detection capability in varying sea states.

MEL expertise in the development of advanced landing guidance was stressed by displays centred on the MADGE Microwave Landing Systems by exhibits of production items of ground and airborne equipment. MADGE, which was selected by NATO as the winner of a contest for a tactical landing aid, continues to be the subject of interest from military authorities in both the UK and from overseas. MEL is currently engaged in a continuing military developmental programme which exploits the basic data link concept providing sophisticated air/ground data terminals which provide segmented approach profiles and offset touch down points as well as the interchange of other data between the aircraft and the ground.

As part of the international Philips Group, MEL collaborates in the marketing of products manufactured by fellow members of Philips in Aviation and recently gained the first British sale of the Magnavox ARC164 airborne UHF radio communication system, a number of which are to be installed in British Aerospace Hawk aircraft destined for an export customer.

An MEL contribution to aviation safety and efficiency, in both military and civil spheres, will be seen in the form of the Mark III radiosonde which is in quantity production for the British Meterological Office. The Mark III is a balloon-borne upper air data collection and transmission equipment of proven high reliability. Obtaining pressure, temperature and humidity information at altitudes up to 30 kilometres, these sondes constitute an invaluable tool for regional and local weather forecasting.

Data gathered by the sonde is relayed to a ground station at regular altitude intervals as the sonde ascends, a function which calls for the highest degree of dependability and confidence in the equipment. A complete sonde, plus a showcase exhibit of an "exploded" unit, depicted this aspect of MEL's involvement in the many-faceted world of aerospace.

NORMALAIR-GARRETT

At Farnborough, Normalair-Garrett Limited was emphasising its systems capability and design leadership in several diverse fields within the aerospace equipment market.

Environmental Control System

With the development by N-GL of cooling turbines capable of operating at sub-zero °C temperature, considerable reductions in the consumption of engine bleed air by air conditioning systems can be achieved. By comparison with conventional air conditioning sytems, a 100 seat passenger aircraft achieves fuel savings equivalent to £6 per flying hour, with an N-GL recirculation air-system based on this new concept. The technology which has now been applied to production equipment for the Lynx helicopter was fully illustrated.

The principle has also been employed, and proven by tests, in the engineering proposals for the system for the British Aerospace HS 146 airliner. This system also incorporates important technological advances to increase overhaul life and reliability.

Full advantage has been taken of the millions of hours experience of Garret-AiResearch with cooling turbines, incorporating air bearings, supplied for the DC10, A300B, C5A, Cessna 550, Sabreliner and F18 aircraft. The N-GL system proposed for the HS 146 would therefore be cleared to enter service with an "on condition" overhaul life.

Life Support Systems

The complete oxygen system supplied by N-GL for the Tornado aircraft was on display. The N-GL seat mounted system has an excellent reputation for operational simplicity and safety. It features automatic control of air/oxygen mixture and breathing pressure; in addition its low breathing resistance and the compact mask design has gained good acceptability with flying personnel.

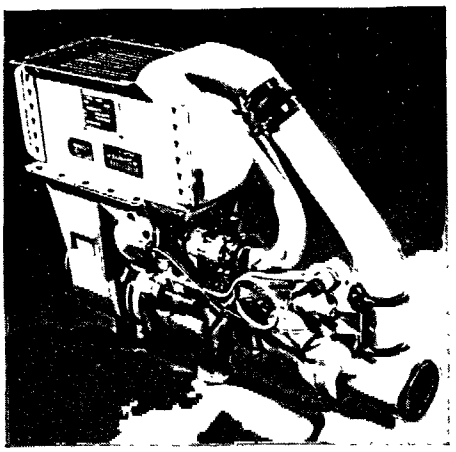
Flying Controls

N-GL's capability in mechanical actuation for flight control equipment is based upon the extensive experience and product range of the Garrett Corporation (USA). N-GL is showing a new hingeline rotary actuator that converts the conventional high-speed, low torque shaft input drive into low speed, high torque output for positioning flight control surfaces.

Hydraulics

N-GL was showing a range of components depicting its growing capability in design and production of hydraulic systems.

The display included a bi-directional pump, pressure gauges, servo control valves and auctuators which have been selected to illustrate the small size and low mass of the N-GL equipment that is currently in production for applications on both conventional aircraft and helicopters.



A new generation cooling pack which requires less input power than conventional designs has been developed for the Lynx helicopter by Normalair-Garrett Limited.

Avionics

N-GL is introducing a digital data recorder developed for the McDonnell Douglas F18 US Navy combat aircraft programme.

The recorder is an integral part of a Bendix Maintenance Data Recording System that operates with the aircraft mission computer to analyse serviceability of the engines and critical airframe components and systems.

With a storage capacity of 12 Mega bits, it records and replays, error free, 30,000 bits per second during prolonged operation under severe vibration and extremes of temperature.

Filtration Products

N-GL has the design and manufacturing capability to solve a variety of special filtration problems. Exhibits include filters for fuel, hydraulic and air systems that have been designed to meet the high standards of reliability and quality demanded by the aerospace industry.

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

Investment Castings

The N-GL foundry division was represented by a selection of vacuum and air-cast components produced by the lost wax process. These include high strength maraging steel castings which are now replacing forgings for use in many aircraft systems including weapon and structural components.

RIST'S WIRES AND CABLES

Rist's showed lightweight equipment wires.

Keeping abreast with the general trend towards miniaturisation in aircraft and electronic circuitry, Rists showed their new range of TFE Equipment Wires.

Compared with older types of cable, TFE wires are real space savers, ideal for the high density wiring packages you find in electronics. Although of reduced insulation thickness, they are tougher and high resistant to abrasion and sharp edged materials.

The stand also showed the company's capability in the design and manufacture of wiring assemblies for jet engines, electronics and telecommunications equipment.

BOC AVIATION

BOC Aviation's Stand demonstrated the current and projected range of products in the field of aviation life-support systems.

A simple, low cost but effective seat mounted oxygen regulator system has developed and can be supplied either with or without pressure breathing facility. An initial order for 120 sets of this equipment has been signed with CASA of Spain for installation in the C-101 trainer now in production. First deliveries of the equipment are due to take place before the end of the year.

Whilst on the subject of aircrew oxygen systems, BOC Aviation is in the final design stages of two associated test sets. One is a low cost system for use in-situ, enabling oxygen regulation systems to be tested without removal from the aircraft. The second is a more sophisticated set for use in servicing bays.

BOC Aviation has developed and supplied liquid oxygen (LOX) converters for military aircraft, and production orders have been received for a five litre converter for the new Sea Harrier. Looking to the future, BOC's resources are being used to develop an on-board oxygen generating system (OBOGS) and a high pressure gaseous oxygen system.

Also designed for use with the Sea Harrier, but capable of a wide range of applications, is the new 100 litre LOX ground dispenser. This advanced item of ground support equipment is highly manoeuvrable and is capable of being transported suspended beneath a helicopter for use in difficult tactical situations. The unit is in quantity production for the Royal Air Force and an enlarged version holding 200 litres of LOX is being developed.

Other equipment under development includes a fuel tank inerting system designed for the Tornado, for which production orders are expected shortly, and an automatic inflation unit for aircrew life jackets which has been undergoing trials by the Royal Air Force.

DELANEY GALLAY DYNAMICS

A wide range of heating, cooling and anti-vibration equipment for aircraft and avionics was displayed by Delaney Gallay Dynamics Limited.

Prominently featured on the stand of this British company, which this year celebrates its Diamond Jubilee, were examples of anti-vibration mountings. These are produced by the DG Vibration and Shock Control division, which was formed 16 years ago with an eye on aerospace requirements and is currently the only UK manufacturer offering a complete service in vibration mountings.

Designed to protect relatively delicate equipment from harmful surrounding vibration, the mountings include Standard Mounts (all-metal); mountings for aero engines, Special Mountings (all-metal) and pipe clips as supplied to Rolls-Royce to clip high temperature pipework on gas turbines.

Another special feature of the display was the DG Dynamics Liquid Conditioning Pack for the environmental control of aircrew, developed in association with a liquid conditioned coverall for the Ministry of Defence. The pack provides conditioned fluid, either heated or cooled, to the coverall which will be worn by airborne personnel operating in a hostile climatic environment.

Other DG Dynamics' products on view at Farnborough included:

Two pass cross-contra flow, secondary surface pre-cooler for Jaguar air system. This unit will cope with complex installation requirements and thermal insulation is incorporated to maintain acceptable external temperatures.

Stainless steel fuel heater assembly for the Olympus 593 engine.

Vapour cycle air chiller pack for British Airways B747 galley refrigeration. A fully self-contained unit which uses cabin air as a condenser heat sink and is powered by aircraft 200V/400Hz 3 phase AC supply.

Pod mounted vapour cycle air chiller pack for cooling test equipment. This fully self-contained unit uses ram/fan induced ambient air as heat sink for condenser, powered by aircraft 200V/400Hz 3 phase AC and 28 VDC supplies.

Single stage axial fan for Lynx helicopter with avionics cooling and cabin air conditioning.

Two stage axial fan assembly for Concorde with electronics cooling.

Mixer unit combining engine bleed air with ambient fan induced air for Lynx helicopter cabin heating.

Integrated oil cooler and fan assembly for the Rolls-Royce Gem turboshaft engine.

Integrated tow pass cross contra flow precooler and intercooler for British Aerospace Sea Harrier air system.

INTERNATIONAL MILITARY SERVICES

International Military Services Limited, the commercial arm of the Ministry of Defence, made its first public appearance at Farnborough.

IMS was formed on the 30th June this year to take over the operations of Millbank Technical Services Limited. The company acts for the United Kingdom Government in Government-to-Government contracts in the defence field. It offers the facility for packaging together in one contract aspects ranging from feasibility studies to the supply of equipment for land, sea and air forces, construction work for defence installations and supporting services in the fields of personnel training and maintenance.

The facility has become increasingly attractive to overseas governments who would otherwise be required to enter into and manage a variety of individual contracts with United Kingdom commercial companies and government agencies.

IMS shared the stand of the Defence Sales Organisation of the Ministry of Defence.

Its display highlighted its experience in the area of military airfield construction projects and also conceptual studies and supply of ground-to-air

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

defence systems together with on-going contracts for training and maintenace.

£2 Billion Order Book

Single and multi-source contracts for which IMS is currently responsible are valued at £2 billion and the company makes a significant contribution to employment prospects in British Industry and to the national balance of payments.

Countries in which IMS have been, or are currently active include Algeria, Argentina, the Bahamas, Bahrain, Ecuador, Iran, Jordan, Kenya, Malaysia, Morocco, Nigeria and Tanzania.

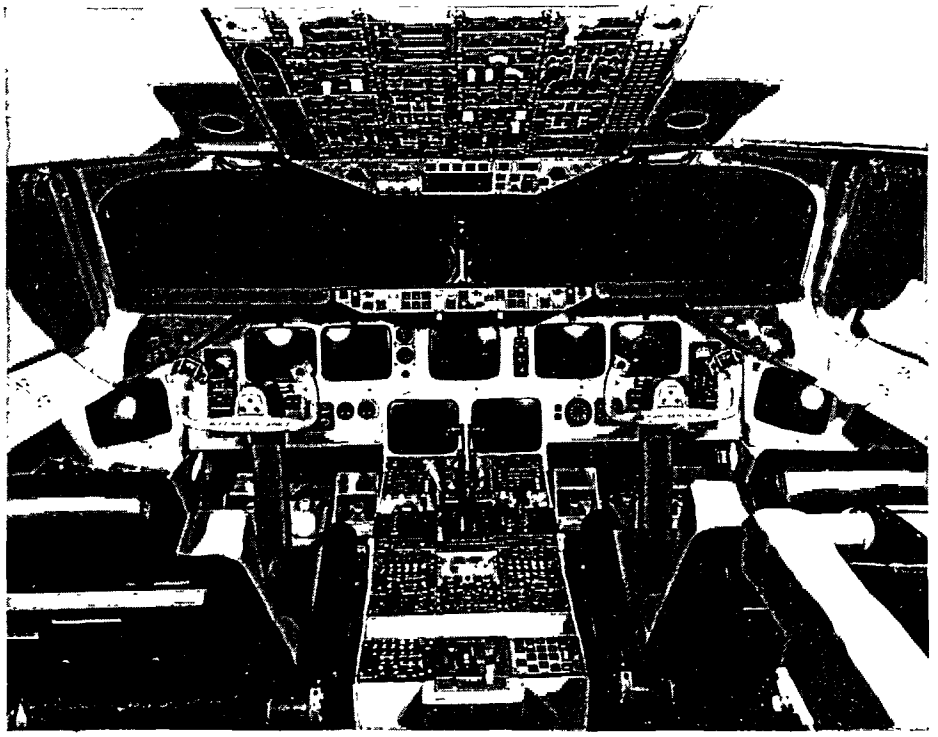
AVIONICS

Indications at Farnborough were that recent trends in avionics technology had been confirmed and the implementation of new systems was being detailed either for improved versions of existing aircraft or for types projected within the next few years. The A300 Airbus, for example, has now reached a point in its successful sales career at which airline customers have ordered another version which is still some considerable time from first flight, in the confident anticipation that it will repeat the good record of the B2 and B4 models already operating.

The Integrated Flight Control System (IFCS) on these aircraft is analogue in nature at present, but it is the intention of **Airbus Industrie** to incorporate a digital autopilot but retain analogue sensors in later B2 and B4 models to enable full certification to be obtained by 1981. Looking a little further ahead to the 245-passenger A310, the digital trend is emphasised still more by the decision to incorporate a complete IFCS (sensors and autopilot) using this philosophy so that it can be certificated by 1983. It has been emphasised by Airbus Industrie that the new type of IFCS has not been dictated by operational capability, since the A300 has been cleared for Cat 3 weather for some time. Maintainability is the major consideration since the number of Line Replacement Units (LRUs) can be reduced from 17 to 7 by changing from an analogue to a digital system.

The exploitation of digital techniques can also be employed in extensive cathode ray tube (CRT) presentation of primary flight information. British Aerospace has been developing new data display systems for some time. which is related to the flying task in the 1980s and 1990s. The whole concept of the fully integrated flight deck has been examined, including a human factors assessment and a comprehensive engineering study. The latter has involved many UK manufacturers and some of the equipment proposed will be fitted in the BAC One-Eleven at RAE Bedford where flight testing is scheduled to begin in the latter part of 1979.

The Advanced Flight Deck used during the programme is a static mock-up at **British Aerospace,** Weybridge, with simulation generated by three minicomputers. The electronic displays are commercial nine-inch CRTs and the waveform generators are those used in a current military aircraft. For the initial part of the programme, the simulation was based on the well-proven VC 10 aircraft. If the flight deck of the VC 10 is compared with its advanced flight deck counterpart, it may be seen that although all the controls and instruments have been repositioned to be accessible by two crew members, the flight deck "clutter" has been considerably reduced. This VC 10-based programme has been completed and the flight deck has been reconfigured and re-programmed to represent a typical wide-bodied, short/medium haul jet transport powered by two RB 211 engines.



Fully automatic navigation and thrust management are features of this system and for the assessment the London-Paris route is flown and all relevant navigation aids are simulated. The seven main displays are allocated to two discrete sub-systems; one presents the flying instrumentation and the other the systems and engine information. Two further displays have been dedicated to documentation such as check lists, navigation charts, meteorology, etc. The various formats have been presented in green monochrome because this, unlike white, can be selectively filtered. However, more advanced colour techniques are being investigated by British Aerospace engineers.

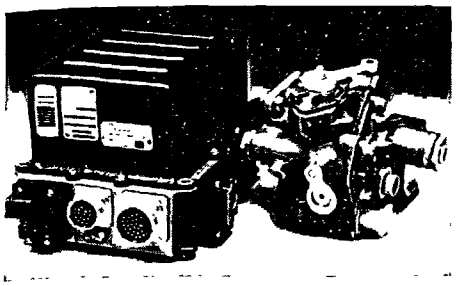
Already, over 1,000 hours of experience has been accrued by more than 30 pilots from a wide variety of organisations in transport aviation. Those who took part soon adapted to the Advanced Flight Deck and their criticisms have in the main, been confined to detail comments.

Helicopter Engine Controls

An indication of another application of electronics came from **Lucas Aerospace** which company is developing full authority helicopter engine controls which have in fact, been tested on several engines and with complete transmission systems. The first type, SDS 100, utilises analogue computing methods and has recently successfully completed its first trials flight in a Bell 222 helicopter. The other type, SDS 200 uses a digital computer and by means of microprocessors and related techniques, any required degree of

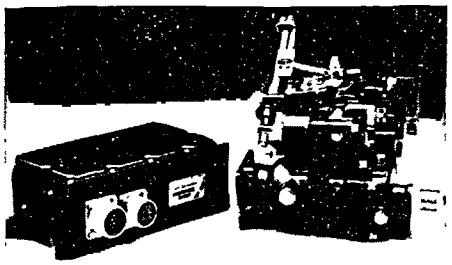
Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007



SDS-100 Full Authority (ECU) engine control unit with analogue computer.

system sophistication can be programmed to give overall powerplant control from start-up to shut-down.



SDS-200 Full Authority (ECU) engine control unit with digital computer.

Both systems are designed for a wide variety of applications and are modular with the electronic control unit (ECU) differing little from standard for each type of unit. The fuel metering system (FMS) can be supplied for engines from 600 shp to 1,100 shp and in addition, the various end user requirements of inlet guide vane control, manual reversion, altitude compensation, etc, can be incorporated as necessary.

It was envisaged in the design of these systems that the maximum use should be made of electronic computation with the mechanical functions minimised. With specific reference to the SDS 100, design of an electronic control for small gas turbine engines began some years ago with the LTS 101 powerplant envisaged as the first application. The computational powers of electronic technology mean that compressor shaft acceleration can be used as a control parameter, which offers distinct advantages over other more conventional quantities since it makes use of the single most accurately and easily measured output function of a gas turbine, namely compressor speed.

The SDS 100 system is powered by the aircraft electrical supply until the helicopter rotor is up to 50 per cent speed when an engine mounted, turbine driven alternator provides electrical power. Failure of the alternator supply results in an automatic change over to the aircraft power supply. Control is provided by two field replaceable units; an electronic control unit and a fuel metering system. They are connected by a single harness which also carries power from the engine-mounted alternator and the inputs from two monopole speed pickups on the engine gearbox. Interface with the helicopter is provided by a mechanical link to the power condition lever (throttle) in the cockpit, and an electrical harness, which also carries the torque matching signals between engines.

The engine mounted alternator manufactured by Simmonds Precision is driven by the power turbine and is dedicated to the power supply of the control unit. In this way, before the helicopter takes off, the alternator is at speed and has assumed the electrical load. In addition the electronic control unit gives warning to the pilot if the alternator fails, so that during every engine start, the functional status of both power supplies is checked.

A significant technological advance in propulsion control is claimed by **Lucas Aerospace** in the display of the second generation, **SDS 200** full authority digital controller. This has been developed for current and future civil and military gas turbines and will exercise complete engine management over the entire flight envelope, while being suitable for complex, mult-variable propulsion systems.

Military Cockpit Display

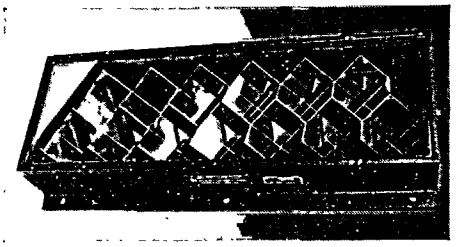
The development and supply of the Combined Map and Electronic Display (COMED) for the McDonnell Douglas A 18 Hornet will be undertaken by **Ferranti,** with some work being carried out by the Bendix Corporation under licence to Ferranti. This was described in detail in our July issue.

Modern military aircraft fly low to minimise the chance of being detected by the enemy, but in so doing the pilot's "look ahead" range is severely diminished. Flying a complex route at high speed with all the other military tasks to perform means a very high work load for the pilot. Equipment such as inertial systems will reduce the peak to some extent, but alpha-numeric positional or guidance data is not readily assimilated and head-up guidance does not help the pilot to relate to the tactical situation. A topographical map is required and in recent years this has given rise to the moving map display.

Flight Inspection System

From **Litton Systems of Canada** has come the Inertial Referenced Flight Inspection System which, when coupled with the normal nav-air receiver, is a self-contained En route and Terminal Navaid facility. Unlike others of this kind, the Litton system does not require ground personnel operating theodolites or other supporting equipment since ILS or MLS calibration is performed by comparing in real time, the received guidance signals with accurate aircraft position determined by the Inertial Referenced System.

Included in the aircraft equipment is a developed minicomputer, the proven Litton inertial navigation system which provides data every 50 milliseconds for aircraft position determination, and a Litton-developed infra-red scanning camera that employs two arrays of high power light emitting diodes (LED) as sources of infra-red energy. This energy is returned to the camera by retroreflectors mounted



close to the runway in surveyed locations. The returned energy is detected by each of the two linear photo-diode arrays, and coupled with aircraft altitude data from the inertial system, allows the instantaneous aircraft position to be calculated with great precision, in three orthoganol axes. A digital subsystem is also employed that provides the required signal conditioning to interface the analogue navaid receiver to the system's general purpose computer.

Varied Components and Systems

Among notable exhibits was one by **American Avitron** illustrating the F-16 Fly-By-Wire Flight Control System, in which not only are there no mechanical linkages with all signals transmitted electrically, but the side-stick controller does not move either. It senses the force applied by the pilot and sends an electrical signal proportional to the force.

This company also showed the Performance Data Computer System developed for the Boeing Commercial

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

Airplane Company, which computes optimum speed and thrust settings for flight crews based on operating conditions such as temperature, zero fuel weight, altitude, wind and destination. Instructions for the crew are updated en route as conditions of the flight change.

The French **SFENA** company showed a wide range of products including the Lasergyro which is claimed to offer considerable advantages over a conventional rate gyro, mainly because there are no moving parts. It is constructed around a gas laser which emits two independent beams of light. These beams travel along the same path but in opposite directions within a triangular, totally enclosed resonant cavity which incorporates a high quality mirror in each angle of the triangle. If there is rotation about one of the axes perpendicular to the plane of the cavity, the distance travelled by each light beam will be different. This difference can be measured and the value can be used to determine the angular rate of this rotation.

Also featured by SFENA was SAPHIR which is a modular helicopter autopilot/flight director system designed for operation with electro-mechanical control actuators or electro-hydraulic servocontrols. The system has a wide range of possible configurations, from a basic simplex two-axis stabilisation and attitude hold system to one with duplex fail-passive cycle channels. The system is so arranged that the pilot can manoeuvre the helicopter at any time through the engaged facility by means of its normal flight controls, and it operates in conjunction with various components and other equipment.

Details were available of work by the **Royal Signals and Radar Establishment** (RSRE) Malvern and demonstrations were shown of Visible Laser Radar Velocimetry used in advanced technology for aerodynamics research into jet engines, turbines, compressors, etc. Equipment of this type is used for example, in RB 211 research, and is capable of measuring flow velocities up to at least Mach 4 and with high levels of turbulence.

The instrument is a form of optical radar using two visible laser beams which are directed into the flow at the point of interest. Tiny particles suspended in the flow scatter the light which is then collected and analysed by the Malvern Correlator system, this being the heart of the instrument which makes use of the fundamental properties of laser light and photomultiplier detectors to extract the maximum amount of information from every photon received at the detector. The results are displayed on a TV screen and velocity and turbulence levels can be calculated very quickly.

Simulator technology was illustrated by **Redifon**, which company has recently completed the first commercial helicopter simulator. It is mounted on a six degree of freedom motion system incorporating all movements associated with helicopter VTOL characteristics, and in addition is fitted with a subsystem which provides realistic simulation of the vibration levels associated with rotating wing aircraft. The visual system for this British Airways Helicopters simulator is the first to provide simulation of oil platform landing and allows for a total of over 6,000 light points and up to 200 surfaces providing features which include horizon, stars, surface texture and markings, buildings, surrounding terrain, moving vehicles and landing lights.

New Long Range Radar

Marconi Radar Systems introduced a new development at Farnborough designed to meet the requirements of the 1980s and beyond as regards high resistance to jamming and interference coupled with a long range and bearing discrimination. It is the Martello system which is a transportable, 3-D, L-band radar incorporating advanced techniques in signal processing to provide fully automatic detection and plotting of targets in an electronic countermeasure (ECM) environment. The system is designed to meet the threat of attacking aircraft with high speed and high manoeuvrability in all three dimensions which require initial detection at the greatest possible range to allow sufficient time for engagement by appropriate weapons. Accurate and continuous positional tracking is also required as well as frequent height measurements to ensure that tactical height changes can be detected in good time.

Martello consists of an antenna, a radar, container, cooling/air conditioning unit and a power generation unit which are all based on the LSO freight container so that they can be transported by standard prime movers or carried in transport aircraft such as the C-130. The system can be deployed and into action in six hours. Martello is based on the need to give range, bearing and height data on all targets within the radar cover on each of the antenna and providing at the same time an effective counter to all forms of ECM and clutter. Two principles have therefore been borne in mind in its design; freedom of choice of any frequency in the operating band at any moment of time, and the need to keep antenna side lobes as low as possible.

A number of features are of importance in connection with these principles, including the use of a planar array with accurately controlled power distribution and parallel processing of received signals to obviate the need for elevation scanning by frequency or other means. The array is constructed of 60 identical horizontal elements stacked vertically, and rotates at 6 rpm. Each horizontal element is a set of dipoles fed in phase, and with a carefully shaped amplitude distribution to ensure very low sidelobes. To speed deployment, the horizontal elements are pre-assembled into 12 interchangeable modules for attachment to the antenna spines.

Each of the 60 array elements receives returns which are assembled into a passive i f beam forming network. This forms nine beam patterns to achieve the required vertical cover and heightfinding accuracy. Cover is provided from the radar horizon up to 30°, with height measurement up to 24° elevation and the array is tilted backwards at an angle of approximately 14°, the bottom beam being flat along the ground (ie, all beams are fixed in elevation). The system is designed to operate in wind strengths up to 70 knots and to survive gusts of up to 120 knots. The IFF/SSR antenna is mounted on top of the primary antenna and the Martello radar contains a complete IFF/SSR system which provides sidelobe-suppressed automatic plot and mode/code data on military and civil modes 1; 2; 3A, B, C and D, with the range performance matched to that of the primary radar.

Improved visibility in clutter is achieved by pulse compression as part of the processing in each beam, and the Marconi transmitter is fully automatic in operation with a peak output power of 3.3 MW. The plot extractor detects the presence of the target, determines its range, bearing and height, and presents the resultant data in the form of narrow-band messages suitable for

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007

transmission by standard means. The implementation of the extraction process is in two stages, the Plot Forming Unit carrying out all the target detection and elevation determination processes, while the Locus Data Processor computes the target azimuth and height and takes account of any variables.

Outputs from the Martello system can operate a radar display system via either broadband and narrow band radio links or suitable cable. These can be in the form of primary radar plot data, IFF/SSR plot data, combined with the first, or a combination of outputs including Video Signals, Sync and Turning data.

Improved Techniques

A means of increasing Secondary Surveillance Radar (SSR) accuracy has been developed over some time by **Cossor Electronics.** Monopulse techniques are improving the integrity of SSR information presented at the ADSEL evaluation station at Matching Green and although an essential part of the ADSEL system, the Cossor techniques can be implemented on current SSR systems with marked improvements in performance.

The provision of SSR information in modern automated Air Traffic Control systems is vitally important and as the numbers of aircraft steadily increase, improvements to the quality and integrity of radar information becomes increasingly necessary. The new Cossor monopulse technique was developed to overcome problems inherent in the present method of measuring the bearing of an aircraft, in which all transponder replies are stored as the antenna beam sweeps the aircraft. Typically, 21 replies are received from each aircraft per antenna revolution, the replies corresponding to an arc of 4° and the actual position of the aircraft is determined as the centre of the replies, ie, number 11. This method has worked well in the past, but inaccuracies occur when a complete set of consecutive replies is not received, and this situation is becoming more common as the density of airspace utilisation increases.

The Cossor monopulse method of determining an aircraft's bearing requires only a single transponder reply. Two antenna patterns are employed, these being capable of accurately measuring the bearing of an aircraft within the antenna beam. Considerable improvements in accuracy are achieved by this method and it also offers the prospect of improving safety standards and giving better utilisation of airspace.

An Integrated System

From the Swedish company of **Datasaab** has come details of how their products are helping to modernise Sweden's ATC system. The programme started with the implementation of a new training school near Malmo equipped with a large computerised simulator designed for both systems evaluation and controller training. This has progressed with the provision of advanced facilities and now the first phase of the country's Air Traffic Control Automated System (ATCAS 1) has reached the commissioning stage. It comprises the new centre at Arlanda Airport, Stockholm, and its ancillary services, radars, data links, etc. The Datasaab company will also provide ATCAS 2 to be installed at Malmo/Sturup, to become operational in the 1980s.

Certain ATC and defence centres are directly connected to ATCAS 1 and there will be a total of five Primary Radar/SSR stations to provide ATCAS 1 with data. At each position at the centre, the controller may select for display data derived from a single radar station, or a composite (mosaic) picture from up to three radar stations. When using a mosaic picture the data handling area (which is much larger than the Flight Information Region) is divided into several segments.

It has been emphasised by Datasaab that it is able to design and manufacture complete air traffic control systems that give improved exploitation of airspace in the modern environment by more effective use of radar data. This takes the form of increased distribution of this data using narrow-band links, automatic extraction and display of positional information, automatic tracking, multi-radar processing and display of mosaic radar picture, and automatic extraction and display of weather information. The controller workload also has to be reduced and this is achieved by the printing and distribution of flight progress strips, calculation of estimated times, display of flight data in lists providing advance information to radar controllers for planning and co-ordination purposes, SSR code allocation, association between radar and flight plan data, and radar handovers.

Advanced Landing Guidance

MEL (a division of Philips Electronic and Associated Industries) continue with their development of advanced landing guidance with the emphasis on MADGE Microwave Landing System. A continuing military programme is currently occupying the company which exploits the basic data link concept providing sophisticated air/ground data terminals which can detail segmented approach profiles and offset touch down points, as well as the inter-change of other data between the aircraft and the ground.

On the civil side, Mobil has purchased the MADGE system in order to enhance the safety of offshore flight operations. The system is suited to the offshore role, since it guides the helicopter over a flight path 200 metres to one side of the platform rather than directly to what may be the only obstruction within miles—the platform itself. In the event of a missed approach, the pilot can initiate his overshoot action with full confidence that he is not on a collision course. The system provides accurate glideslope, localiser and distance-to-go information over a range of at least 20 nautical miles and enables day or night operations to be maintained in weather conditions and visibility which would otherwise inhibit North Sea offshore air supply services.

RACAL MERGER CREATES NEW ACOUSTICS COMPANY

A new operating company, Racal Acoustics Limited, has been formed from the merger of S G Brown Communications Limited and Racal-Amplivox Limited, both long established and highly successful Racal companies supplying audio accessories to the communications industry in civil and defence world markets.

Production will continue at the Watford and Wembley factories of S G Brown Communications and Racal-Amplivox, but all future business operations and overall control of the new company, Racal Acoustics Limited, will be centralised at the headquarters in Beresford Avenue, Wembley.

Downloaded by University of Liverpool At 20:05 18 July 2016 (PT)

© Emerald Backfiles 2007